

PATENT

PATENT

of

for

MAGNETIC SLEEVE ASSEMBLY

1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	23
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TITLE OF THE INVENTION

Magnetic Sleeve Assembly

CROSS REFERENCE TO RELATED APPLICATIONS

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Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED

RESEARCH OR DEVELOPMENT

Not Applicable

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BACKGROUND OF THE INVENTION

Field of the Invention - This invention is in the field of linear electromechanical transducers, motors, or alternators, particularly as might be used in a linear refrigerant compressor motor.

15 Background Art - In the field of electromechanical alternators and motors, the generation of a time changing magnetic field in the vicinity of an electrical conductor can induce a voltage in the conductor, resulting in the flow of electrical current. Similarly, passing a time changing electrical current through an electrical conductor generates a time changing magnetic field, and this time changing magnetic field can be used to create mechanical motion. This principle is used to build motors for various uses, including
20 motors used to drive refrigeration compressors.

In some refrigeration compressors, such as those used in cryogenic compressors, it can be beneficial to use a linear motor built on this principle. A cylindrical support sleeve can have a plurality of magnets mounted thereon, to create a magnetic assembly. This
25 magnetic assembly can be mounted for linear translational, reciprocating, motion. Generation of a time changing electrical field imposes a time changing magnetic field on this magnetic assembly, causing it to reciprocate. The magnetic assembly can be attached to a compressor, to drive the compressor and compress the cryogenic refrigerant.

Known devices which utilize these design principles typically attach the magnets
30 to the cylindrical support sleeve by the use of an adhesive. The adhesives used for this

purpose may outgas in certain environments. Unfortunately, in some such compressors, this outgassing of the adhesive may introduce undesirable impurities into the flowpath of the cryogenic refrigerant. This can result in the plugging of small passages in the refrigerant flowpath, especially in miniature cryogenic systems, such as those used in some medical catheter systems.

BRIEF SUMMARY OF THE INVENTION

The present invention includes a slotted cylindrical support sleeve to which are attached a plurality of magnets. Preferably, no adhesive is used in this magnetic assembly. The magnets may be attached to the support sleeve by circumferential support brackets which are in continuous contact with beveled bearing surfaces on the magnets. The support brackets may have angled lips which extend over and contact, along a line of contact, the beveled bearing surfaces on the magnets. As the magnets and the support sleeve expand and contract, the lips move up or down the beveled bearing surfaces on the magnets, maintaining continuous contact and continually forcing the magnets against the support sleeve.

Since, in certain embodiments, no adhesives are used, there is no harmful outgassing. Since, in certain embodiments, there are no spaces, or minimal spaces, between the support brackets and the magnets, the assembly is less prone to becoming loose.

The novel features of this invention, as well as the invention itself, will be best understood from the attached drawings, taken along with the following description, in which similar reference characters refer to similar parts, and in which:

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Figure 1 is a perspective view of a magnetic sleeve assembly according to the present invention;

Figure 2 is a perspective view of the magnetic sleeve assembly shown in Figure 1, from the opposite perspective;

between the two mounting rings 22 and holds the magnets 16 firmly against the support sleeve 12. Instead of the continuous mounting rings 22 shown, segmented mounting rings or brackets (not shown) could be used.

As shown in greater detail in Figure 6, each end of each magnet 16 preferably has
5 an annular beveled bearing surface 24 which faces generally radially outwardly from the support sleeve 12. The beveled bearing surfaces 24 on the ends of the magnets 16 are generally in annular alignment with each other. The mounting ring 22 has a base 25, which is mounted directly to the external peripheral surface of the support sleeve 12. The mounting ring 22 also has an angled lip 26 extending over the ends of the magnets 16,
10 and contacting the beveled bearing surfaces 24 on the ends of the magnets 16. Upon installation, the angled lip 26 can flex slightly because of forcible contact with the magnet 16. Contact between the angled lip 26 of the mounting ring 22 and the beveled bearing surface 24 of the magnet 16 is along a single annular line of contact 28. The annular lines of contact 28 on the bearing surfaces 24 of the ends of the magnets 16 are generally in
15 annular alignment with each other.

The beveled bearing surface 24 on the end of the magnet 16 is angled at a first acute angle A, relative to the wall of the support sleeve 12. The angled lip 26 on the mounting ring 22 is angled at a second acute angle B, relative to the wall of the support sleeve 12. The first acute angle A is greater than the second acute angle B, thereby
20 insuring that contact between the beveled bearing surface 24 and the angled lip 26 is only along a single annular line of contact 28. The difference in magnitude between acute angle A and acute angle B is preferably less than approximately 10 degrees, and preferably in the range of approximately two degrees to approximately four degrees. The first acute angle A, for example, can be approximately 45 degrees, while the second acute
25 angle B, for example, can be approximately 42 degrees.

If the magnet 16 contracts faster than the support sleeve 12, or if the support sleeve 12 expands faster than the magnet 16, the line of contact 28 will move downwardly along the beveled bearing surface 24 as the angled lip 26 straightens slightly. Conversely, if the magnet 16 expands faster than the support sleeve 12, or if the support
30 sleeve 12 contracts faster than the magnet 16, the line of contact 28 will move upwardly

along the beveled bearing surface 24, as the angled lip 26 flexes slightly further upwardly. In either case, secure contact is always maintained between the magnet 16 and the mounting ring 22.

5 It can be seen that, as differential thermal expansion takes place between the magnet 16 and the support sleeve 12, the line of contact 28 will move up or down along the beveled bearing surface 24, maintaining forcible contact at all times between the mounting ring 22 and the magnet 16. This continuous contact maintains an inward force at all times on the magnets 16, thereby always holding the magnets 16 securely in place longitudinally, without room for vibration.

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While the particular invention as herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages hereinbefore stated, it is to be understood that this disclosure is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended other than as described
15 in the appended claims.